

Lecture Module - Data Acquisition

ME3023 - Measurements in Mechanical Systems

Mechanical Engineering

Tennessee Technological University

Topic 2 - DAQ Hardware and Applications

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- Signal Types and DAQ
- EMI Considerations
- Available Hardware
- Software Integration

Signal Types and DAQ

Most data acquisition devices and systems measure and record **analog** voltage signals and possibly additional signal types. Signal **generation** may also be a feature on some systems.

A voltage signal requires a **common** reference or **ground**.

Signal Sources:

- Grounded or Ground-Referenced
- Ungrounded or Floating

Measurement (DAQ) Systems:

- Common Ground
- Common Mode Voltage
- Isolated Ground

Signal Types and DAQ

Most data acquisition devices and systems measure and record **analog** voltage signals and possibly additional signal types. Signal **generation** may also be a feature on some systems.

2 Major Configurations:

- Single-Ended Signals

The signal is measured as a voltage between a **single** conductor and the **ground** which must be carried on a separate conductor or wire.

- Double-Ended (Differential) Signals

The signal is measured as the **difference** between two voltages (**double**) carried on separate conductors, or wires. Typically a **ground** is shared between the two devices requiring a third conductor.

Signal Types and DAQ

Single-Ended Signals

Pros:

Cons:

Double-Ended Signals

Pros:

Cons:

EMI Considerations

Electromagnetic interference (EMI), also called radio-frequency interference (RFI) when in the radio frequency spectrum, is a disturbance generated by an external source that affects an electrical circuit by electromagnetic induction, electrostatic coupling, or conduction.

A *combination* of naturally occurring and human made sources of interference is always present. The total EMI affecting a system is determined by the local conditions as well as global environmental influences.

Sources of EMI:

- Television transmission, cellular networks, AM FM radio
- Lightning storms, solar activity
- Power transmission Lines
- Electronic devices such as computers, power supplies, motors, welders
- Intentional (weaponized) EMI

EMI Considerations

In data acquisition, electromagnetic interference (EMI) can cause reduction of signal quality and data loss due in the form of **noise** and or **drift**.

Consider the case of an analog signal transmitted from a sensor to a DAQ device.
What can be done to avoid issues associated with EMI?

Methods of reducing EMI affects:

- Proximity - reduce length of signal conductors to minimum, if possible locate on same PCB or in same enclosure
- Differential signal - double ended signals are preferred when EMI is expected and close proximity is not available
- Noise rejection cables/wires - twisted pair, foil sheild, wire braided sheild, combos

Available Hardware

- National Instruments
- Measurement Computing
- dSPACE
- Arduino or other

Software Integration

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- Measurement Computing
- dSPACE
- Arduino or other

Software Integration

some reference